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GROWTH, PRODUCTIVITY AND ITS MEASUREMENT

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During the last few years a lot has been written about the lack of productivity in the United States. The inevitable conclusion of most writers on this subject is that the preeminence of the United States as an industrial nation has gone by and possibly for ever.

As a result of the lingering economic problems faced by the United States and the pressure from the Japanese products in both the domestic and international markets, many people have flocked to Japan to observe the Japanese industrial miracle. The most common conclusion of the experts is that the difference in the productivity between the two nations is caused by the striking contrast between Japanese and the U.S. manufacturing processes in certain vital industries and in the respective general management practices.

There is no doubt that Japan has challenged United States mature industries and took away the leadership position. Shipbuilding, basic steel, textiles, consumer electronics and automobiles are but a few examples. But as one may readily observe, the Japanese have not been immune to challenge themselves. Taiwan, Korea and Singapore have become formidable competitors to Japan in some of the industries we have just mentioned. Shipbuilding and

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textiles are now considered by Japan as "sunset" industries for which an "orderly retreat" is the most appropriate national strategy.

One may stand back and upon reflection ask as to whether we are observing in Japan something unique in the history of entrepreneurship, and innovation. Is there a "Japanese way" or are we observing in the "miracle" the application of some astute strategies for productivity through innovation, which are available to the Japanese firms because of the stage in their evolution?

To answer the above question let us look at some plausible stages in the evolution of firms and industries and identify the logical strategies which firms may follow. To the extent that I will be talking mostly about approaches for increasing productivity through innovaton, I will limit my exposition to the most likely evolutionary path of successful innovative firms.[1] Although parts of this paper are based on theoretical and empirical research of long standing and on certain findings of a more recent research effort on productivity, its dimensions and measurement (Zannetos, et. al 1981; 1982a; 1982b;1982c), as the reader will readily observe, no definitive and deterministic conclusions can be drawn from what follows. To put it simply, we are, as yet, at the hypothesis stage.

I. Stages of Evolution

A. Exploitation of Some Important Comparative Advantage

The inception of a firm usually follows the identification by an entrepreneur or group of entrepreneurs of some comparative advantage that can be exploited to:

(1) Produce a product or service better, usually meaning at a lower cost.

(2) Produce a new product or service to satisfy better an existing need and as a result serve as a substitute for an existing product or service.

(3) Produce or service that is intended to satisfy a demand that does not now exist but is perceived to be important for the future.

To the extent that we will be tracing the evolution of firms from the "me-too" stage of product or service offerings and manufacturing processes to the product innovation stage, categories (2) and (3) above will be treated as subsets of (1). We realize of course that some firms may be able to leap frog over certain stages for part of their operations. Also we must stress at the outset that the evolutionary process is not only hierarchical but also iterative, and that there are "subcycles" encompassing one or more stages of the total evolutionary cycle.

The opportunity set facing an entreprenuer at any moment in time, is not necessarily the same as that facing any other potential entrepreneur. The opportunity sets are relative to the specific environment within which entrepreneurs operate. But and even if the ex ante opportunity sets were universally similar or identical, the important determinant of action is the perceived opportunity set. The latter is definitely dependent upon the associative context of the individual entrepreneur, with the perceived as well

as real comparative advantage influencing the associative context itself. So, again, the opportunity sets upon which entrepreneurs operate are not necessarily identical. That is why some people see opportunities for action in certain data but others do not.

The comparative advantages that are exploited by entrepreneurs refer to the dimensions of the various factors of production, which are: (a) human resources (quantity, quality such as education, discipline, perserverance, work ethic, etc.), (b) capital (quantity and quality, including the availability and characteristics of raw materials), and (c) technology (scientific, engineering and managerial). So that we do not limit ourselves to comparative advantages that refer exclusively to the production function, we must add (d) geographic proximity to the relevant markets.

In order to exploit successfully a comparative advantage associated with human resources, capital or geography, the entrepreneur must be able to imitate technology enough so that overall the new firm may enjoy some total cost advantage within the relevant markets. Initially, the relevant markets are local and provide the new firm with a geographic monopoly, as long as the difference in the economies of scale enjoyed by potential competitors are not greater than the cost of transporting the goods plus the relevant comparative cost advantages of the local producer.

B. Adaptation of Best Available Technology

During stage A the firm that imitates the technology of others normally utilizes it in a suboptimal fashion, because the factor proportions used are dictated by the prices and marginal physical productivities of competitors. The next step, therefore, in the strategy of the new firm is to adapt "foreign" technology to best utilize its comparative advantage within the constraints of the local environment.

Successful adaptation of technology and exploitation of comparative advantages introduces barriers to entry to local markets.[2] Often the cost differences in some factors of production, for example labor, are of such magnitude as to enable newcomers (the firms which imitate and adapt the technology of others) to enter and effectively capture a large share of the market enjoyed by the firms whose technology they imitated. The inital entry of Japanese firms in the international markets for steel, shipbuilding, textiles, watches, cameras, scientific instruments and consumer electronics are cases in point.

Another characteristic of firms in this stage of their evolution is to start to specialize in order to support their strategy of growth. This is the beginning of functional specialization.

C. Process Innovation

Once a firm masters the best technology of competitors and adapts it to fully exploit its comparative advantage, it then invests in process innovation so as to create more barriers to entry for others.

Process innovation is aimed at the production function (cost reduction) given products and services. As long as a firm succeeds in keeping its process technology proprietary the barriers are formidable. The greatest danger at this stage, excluding fraudulent practices, rests with the firm's own employees. It is not uncommon for people to move from one firm to another and carry their employer's process technology with them.

In order to prevent piracy of its process technology the firm may try to license it to others, patent it, encapsulate it in instrumentation and/or aggressively protect its right through litigation. I will not attempt to analyze in detail the pros and cons of each combination of approaches but it is worth noting that process technololgy is likely to be imitated quickly

unless it can be incorporated into complex instrumentation in a cost-effective manner, or its complexity permits specialization of many parts to the point where it takes many employees to get together in order to duplicate all the necessary critical aspects of technology.

In addition to preventing easy imitation of proprietary process technology, instrumentation allows sale of equipment as another product, often to competitors, thus creating an absolute cost barrier to entry and at the same time bringing additional revenue to the firm.[3] Finally, process instrumentation provides consistency in quality (the beginning of product differentiation) and opportunities for increases in manufacturing productivity through capital for labor substitution.[4]

At this stage the firm enters into a phase of further specialization and functionalization of its structure because of the particular strategy it has followed, and because of the complexity inherent in the environment, both internal and external, within which it operates.[5] Heavy investment in manufacturing plant and equipment often follows, so that the firm may realize scale economies, and with it comes investment in geographic-market penetration.

Another consequence of process innovation may be the requirement for input materials of certain specifications that current vendors have difficulty in meeting. Such realization and the difficulties associated with inconsistent quality, costly incoming inspection, erractic deliveries and burdensome expediting, may force the firm to vertically integrate backward not because it necessariliy wants (for profit enhancement or "diversification") but in order to protect the quality and timely delivery of its products as well as get control of its "raw material" costs. In the process, however, it may succeed in deriving "scarcity rent" out of its materials.

So from the elementary stage of unicellular organization to exploit some comparative advantage in some factor of production, the successful firm moves to a stage where it develops and enjoys the benefits of technological innovation at the manufacturing level, creates barriers to entry for others, starts to differentiate its product because of quality (better and consistent quality), creates a structure across functional lines[6] and above all makes it more difficult for others to imitate it, thus gaining a lead-time to plan for the next stage of evolution.

D. Product Innovation

We have suggested, in the case of manufacturing processes of a given product, that the successful firms at first adapt the best process to their environment in order to exploit their comparative advantage, and then innovate. The same process we observe later on applied to the product or products.

In order for a firm to get out of a competitive market situation where, in the case of homogeneous products, normal risks and returns are market determined, it invests in product innovation and develops an operation strategy which is consistent with such a general strategy. Successful product innovation efforts lead to product differentiation, market segmentation, inelastic demand, "monopoly" rents and further growth.

Product innovation necessitates manufacturing process as well as market speicalizaiton. All this activity proliferation and the associated growth and progress is achieved at the expense of simplicity. Life-cycles of products and manufacturing processes must be coordinated as well as the "optima" of all functional specialities. The increased complexity and the realization that specialization must now proceed across product lines because of the special characteristics of product/markets and their associated processes, lead the

firm to organize on a product-line basis, if such an organization does more good than harm as a result of the separation.

If an organization is to remain vital and continue to grow it must continue to invest in product innovation. That much is clear. What is not clear is whether product innovation, under a product-line organization, should be entrusted with the division being responsible for the product which is to be obsoleted by the R&D activity. There is theoretical as well as empirical evidence (Zannetos, et al., 1982 d) that various critical fixities associated with: (1) investment in plant and equipment; (2) management, because of switching costs and biases related to the associative context used for planning purposes[7]; and (c) labor, due to switching and retraining costs, inhibit innovation within organization. These inhibitive factors become more critical the closer one gets to the locus of responsibility for the products and processes that are threatened with obsolesence through innovation.

E. Diversification

If successful product innovation activites continue and the firm exhibits a satsifactory growth[8] thoughts of diversification do not arise. It is only after "maturity" sets in and the expectations regarding growth, of managers, employees in general and the other constitutencies of the firm, are not realized that serious thoughts about diversification are entertained.[9]

Diversification for the corporate strategist does not necessarily mean a venture into products and services that are not related to those currently produced or into technologies or processes not currently used. On the contrary, the "associative context" of managers biases them toward activites related to what they know or they think they know.[10] The first steps, as a result, to "diversification" normally include internal backward and forward vertical integration so that the firm may obtain growth as well as more

control over its "raw materials" and over its ultimate customer base. The latter efforts may put the firm on a collision course with its vendors and customers and many a firm have come to regret such decisions, as they have not analyzed fully the consequences of such moves.

External "diversification" (through acquistion) into related products to serve the same markets is nothing more than a broadening of the market offerings. Such activities, as well as development of similar products internally, often provide complementarities or "synergies". Acquiring a successful firm, rather than developing the same products internally, is more likely to lead to success because of the managerial fixities and the start up costs. Also, and this in the case of technologically complementary products which do not serve the same markets, the probability of success is far greater to acquire through purchase a share of the market than to develop and break into new markets.[11]

Finally, the firm may attempt to rally diversify, either internally or externally, by entering into unrelated markets for unrelated products and unrelated technologies. As our previous arguments may reveal the success of conglomerate diversification efforts is very limited.

F. Maturity

Having exhausted all perceived growth opportunities through exploitation of comparative advantages, process innovation, product innovation and diversification the firm will eventually reach a state of maturity and stagnation. Short of a "revolutionary" change[12] the various critical fixities will definitely lead the firm to a decline, although it may take years before such a stage sets in and unquestionably manifests itself.

The mature or declining firm or industry which finds iteself in the midst of firms enjoying the benefits of productivity increases and at the same

time faces competition from foreign firms exploiting their comparative advantage, is not in an enviable position., especially if the comparative advantage is labor costs. During periods of high productivity, wage increases and benefits tend to be liberal and once the employees get used to regular adjustments in salaries and wages, it is very difficult for the firm to stop let alone reverse the process. Because it is very difficult to separate the contribution of capital, technology and labor and since labor is the only animate resource, it is not surprising to find that salaries, wages and benefits tend to increase faster than the prices of the products of mature firms and industries. Monopoly rents are not the earmark of mature or declining firms or industries, but rather excess capacity, which prevents the firms from exploiting any economies of scale to absorb the wage increases.

II. The Japanese Miracle In Perspective

If we now look at the Japanese industrial miracle within the above framework of evolution, we find enough evidence to support a hypothesis that little if anything is new. Through the analysis, we gain a high respect, however, for a masterful implementation of a strategy of exploitation, by the Japanese, of their comparative advantage to gain a big share of international trade. Life-time employment, company unions, company culture and even "quality circles" have been part of the U.S. as well as European corporate life in days past.[13]

Following World War II, Japan went to the task of rebuilding its devastated industrial base. With a relative abundance of capital for reconstruction, an educated work force and low wages, Japan set out to imitate and adapt the best western technology and launch itself in capital intensive industries and activities which required the painstaking skills of a well-disciplined and low cost labor force. At the time when the Japanese were challenging the United States, United Kindgom, France and Sweden in shipbuilding, their wages were less than one dollar per hour or about 20% of the average wages of shipbuilders in the United States. With modern shipyards and inexpensive labor they in a matter of a few years became the dominant force in the industry. By the late fifties over 55% of all tonnage was built in Japan. Process innovation and the size of shipyards helped reduce the cost of ships built in Japan, with part of the cost reduction being passed on to the shipowners as an inducement. Product innovation followed process innovation and the two impacts combined enabled the ocean transportation industry to realize enormous economies of scale.[14]

The shipbuilding story was repeated in cameras, instruments, textiles synthetic fibers, fertilizers, aluminum steel, consumer electronics,

automobiles and watches. This productivity allowed Japan to grow at a record pace and maintain full employment. In certain industries product innovation has enabled the firms to keep on growing as of now but in others such as shipbuilding, textiles, aluminum and certain types of steel, the declining stage of evolution has set in and is putting to severe test the life-time employment practices of Japanese firms and the policy of the Japanese government for "orderly withdrawal of capacity".[15]

It must be pointed out that Taiwan, South Korea and Singapore are using their comparative advantage of low labor costs to challenge Japan in certain industries, in the same way that Japan has challenged the United States and other industrialized nations. For example at a time when the average wage rate, including benefits for assembly labor in the shipbuilding and automotive industires is about $10 per hour in Japan, as compared to about $20 in the United States, in South Korea it is less than $2.25 per hour. In shipbuilding, South Korea has already wrestled the leadership from Japan and will no doubt attempt to do so in the automotive area.[16] As for technology, the South Koreans are not presently developing anything new; they are producing under license, imitating and adapting the technology of others. So the incessant cycle of evolution, dominance and decline continues, and the conquerors of yesterday become the conquered to today.

Without belittling what Japan has accomplished, after a close scrutiny, we find that the so-called Japanese miracle, and its attributes, are most likely nothing more than a series of adept strategic moves during the various stages of the evolution of the Japanese firms and industries.[17]

III Measurements

The analysis presented above points out that the most effective approach to productivity is through product innovation. The latter permits the firm to realize a monopoly rent as long as the users find that they increase their net utitlity by buying the innovative instead of the substituted product. If product innovation is not feasible, in the long run, stagnation and decline will ensue.

Some firms continuously devote a considerable amount of resources to activities aiming at innovation only to be surprised much later by the failure of their efforts. Others are in crisis without realizing it and by the time they do, they find that it is too late to do anything about it.

In trying to find answers to the U.S. productivity dilemma, many researchers claim that one important impediment to productivity and innovation is the managerial attention to the "bottom line." Because "profits" are used for performance evaluation and reward, the argument goes, managers are encouraged to sacrifice long-run investment possibilities for short-run profits.

Although there is some validity to the above argument, it appears that the difficulty lies in the robustness of the measure itself. Achieving a proper balance between the short run and the long run will always be a problem for managers, as long as there is uncertainty in the future and complementarity of resources at any moment of time and over time. The problems of separability, to which we alluded before in the context of identifying the contribution of the various factors of production are magnified significantly when we introduce "time" and "projects."

In a recent paper dealing with the issues of measure and measurements (Zannetos et al., 1982 b) it was shown that economic value added per dollar

of salaries, wages and benefits is a better measure of productivity than any of the traditional measures used at the level of the industry and the firm.[18] In addition to studying the theoretical properties of alternative measures, an analysis was also made of the information generated when these measure are applied to the U.S. automobile industry.

I will now present some of the results of the above study, or illustration, using General Motors as the case in point.

Exhibit I presents the value added by G.M. over payroll and benefits from 1954 to 1979. It shows that since 1963 productivity, as measured, has been unquestionably declining. And this, in spite of the positive trend in Net Income and Profits per Share shown, respectively, by Exhibits II and III.

If we now look at Exhibit IV, which represents the ratio of the new car price index over the producer price index, we notice the same unequivocal trend observed in Exhibit I. As we have argued before firms which innovate and in so doing add utitlity to the user over competitive products, may extract a monopoly rent. If on the other hand they cannot even pass on to the user cost increases, such an inability indicated not only loss of the comparative advantage of their product by also a loss of leverage vis a vis their vendors or the factors of production.

Exhibit V indicates that the share of foreign imports in the U.S. car market reached its lowest point in 1963 and has been increasing ever since. The shape of Exhibit V is almost the exact opposite of that of Exhibit I and Exhibit IV indicating that once the productivity of G.M. started declining and its economic monopoly power has disappeared, imports started gaining because the U.S. automobile industry became non competitive.[19]

From the above discussion it appears that our present measure of productivity at the firm level must change to reflect the economic value the firm adds per dollar of payroll and benefits. Of the traditional measures

used, and conveniently generated by the accounting system, according to the aforementioned research, net operating income over net sales revenue comes closest to valued added per dollar of payroll and benefits than all the rest.

In the case of General Motors the most commonly used criteria of efficiency, absolute net income and profits per share, have been signaling progress, in the positive trend, for fifteen years after value added per dollar of payroll and benefits reached its peak and started declining. So it may not be that business men are willfully sacrificing the long run for the short run, but rather that the indicators they associate with performance are faulty. Reenforcing this belief is the information provided by Exhibit VI which indicates that capital investment per employee at General Motors has been increasing since 1955 at a very healthy rate.

IV. Conclusion

The issues surrounding productivity are complex and fraught with problems of nonseparability and misinterpretation. The various stages of evolution of the firm seem to provide a plausible explanation for the Japanese miracle, if coupled with astute strategic moves for the erection of barriers to entry.

The commonly advanced propositions that the Japanese management style and practices, as contrasted to those of their American counterparts, are at the root of the Japanese productivity do not seem to hold. We have found, however, that some of the most commonly used indicators of progress are providing false signals and that there are better measures of productivity such as value added per dollar of payroll and benefits.

Footnotes

1. Actually the general charactarristics of evolution are the same and it makes little substantive difference whether one takes present-day technology-based firms or producers of "commodity" products as the subject of analysis. The reason is that even the industries which are now mature are based on technology but they have reached an advanced state in their evolution where innovation has stopped. At the other extreme firms which start with the "idea" of developing a new product, do not possess all the necessary technology in all areas of product development, operations and management. So for certain aspects of their activities these firms may be at a different stage of evolution than they are for others.

2. For a good but concise discussion of "barriers to entry" see Richard Caves, (1967; 4th Ed. 1977) pp. 23-30.

3. There are some interesting strategic issues regarding the pricing as well as obsoleting of equipment for maximizing the long-run profits of the innovator and also creating "cost fixities" for the competitors. For some relevant discussion of the latter issues see: Zannetos, et. al, 1982 d.

4. From studies performed by the author it appears that instrumentation improves, as well as provides consistency in the quality of the product. The reasons for these benefits are mainly (a) the incorporation in the instrumentation of the best or scientific approach to the manufacture of the product thus divorcing, to a certain extent the quality of the product from the quality of manufacturing labor, (b) the greater consistency of "the automation" as compared to that of human beings, (c)

the greater sensitivity of cybernetic controls to small deviatons in quality and (d) to more refined measurement processes permitted by instrumentation.

5. The illustrations and descriptions provided by Chandler (1962), Lawrence and Lorsch (1967) and Galbraith and Nathanson (1978) appear to be consistent with the rationale provided here.

6. In addition to production specialization (production control, quality control) finance (accounting control and financial analysis) and also marketing (product quality) functional specialization start. Furthermore, the foundation is set for development of the overall general management function.

7. The assumption here is that information for motivating action is a function of the availability of appropriate data and of an appropriate associative context. The latter generates meaning. If, therefore, the present practices, especially if these have persisted for a long period of time, have shaped if not fixed the associative context, then it is very likely that current activiteis will bias future activities. So more of the same is is order. Managerial and labor fixities explain the "NIH factor" (Not Invented Here) that is often mentioned in business circles. The arguments presented here raise a lot of interesting issues regarding the trade offs between the time devoted to learning through specialization and gaining experience, on the one hand, and innovation which threatens the experience gained, on the other.

8. This assumes that "profitable growth" is one of the primary long-run objectives of the firm. It provides opportunities for the employees to avoid "fixities" and stagnation, and benefit themselves as well as the organization from the "infusion of new blood" and from the challenge that it brings in terms of both knowledge and "associative context".

9. It is also at this stage that the first, although as yet not critical, test of the Japanese "life-time employment" and seniority wage and promotion systems surfaces.

10. This is not to deny that often search firms are used for identifying potential acquisitions. In these cases the associative context used for the initial selection of candidates is biased by the perceptions of those conducting the search.

11. This indicates the importance of, as well as the costs, associated with market development. Technology, often, may be acquired by recruiting a few technical people from competitors. Development of markets on the other hand requires a lot of contacts on a one-to-one basis, a task that becomes even more difficult if a firm must dislodge someone else to gain a foothold.

12. Such changes usually lead to "amputations" of both product lines as well as management, and recycling through the stages of evolution.

13. Mining companies textile mills, steel mills, United Fruits, United Shoe and Olivetti, among others, are prime examples of firms which have gone through the same stages of evolution some of them several decades ago.

14. The size of vessels built increased from 16,5000 deadweight tons to over 600,000 in a short period of twenty years. If it were not for the oil crisis of 1973 which induced "permanent" changes in the oil consumption pattern worldwide, they would have, in all likelihood, built vessels of over one million deadweight tons by now.

15. For an interesting description of the Japanese philosophy toward declining industries sees Fortune, January 10, 1983 pp. 58-63.

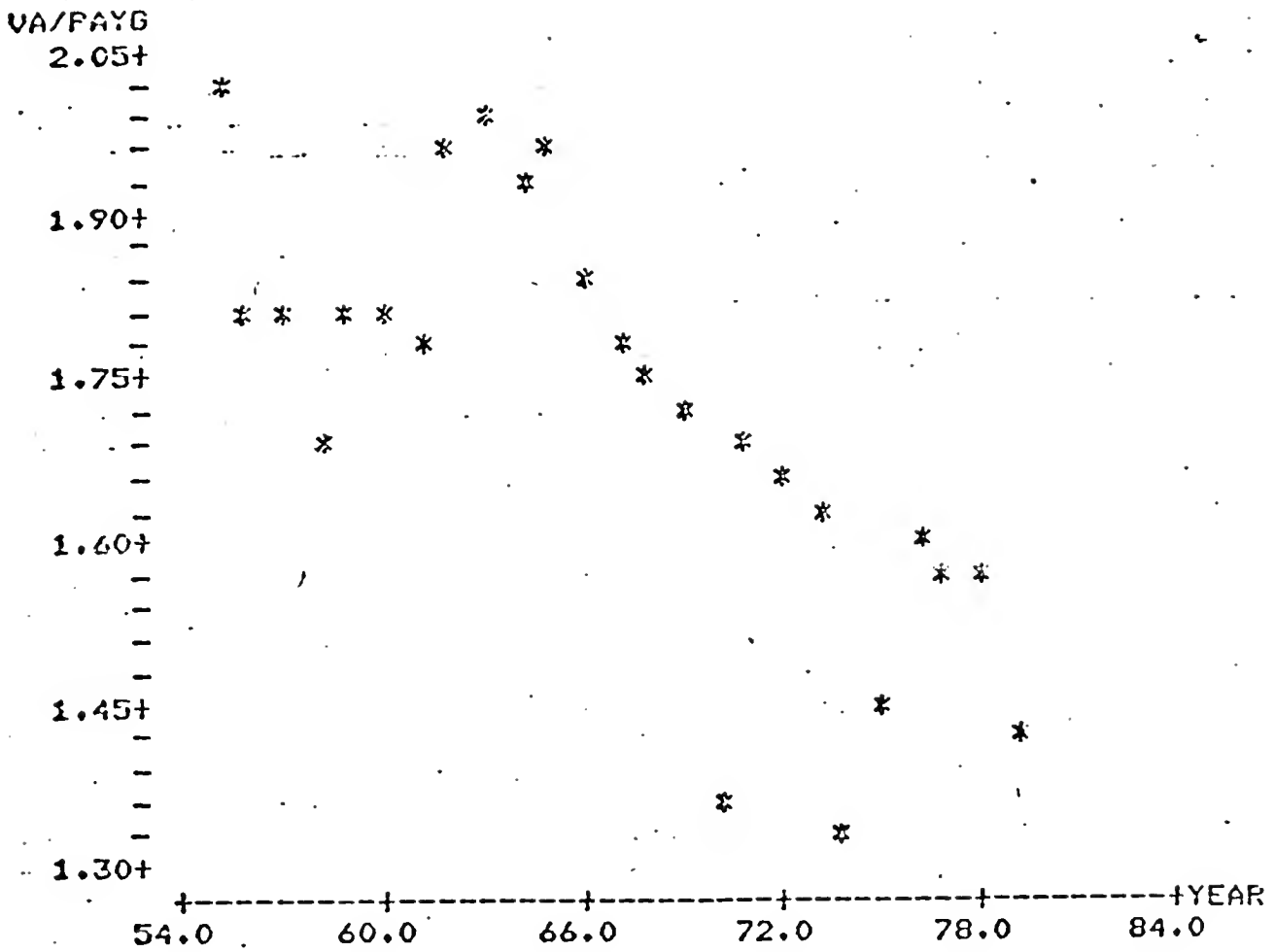
16. In spite a Fortune (January 24, 1983, p.9) statement that South Korea "has no plans to ship (the Pony) to the U.S.", no one should be surprised when the Pony is seen on the U.S. highways.

17. At a recent symposium held at M.I.T. and sponsered by the Sloan School of Management and the M.I.T. Industrial Liaison Program, Hattori (1982) the President of Daini Seikosha gave a fascinating presentation on the evolution of Seiko. What he described provides a beautiful empirical illustration of the main thesis of this paper.

18. The proposed measure combines various desirable attributes such as compensating for relative inflation, indicating the relative monopoly power of the firm to pass along the cost increases versus that of labor to extract higher salaries, wages and benefits and reflecting the relative degree of vertical integration.

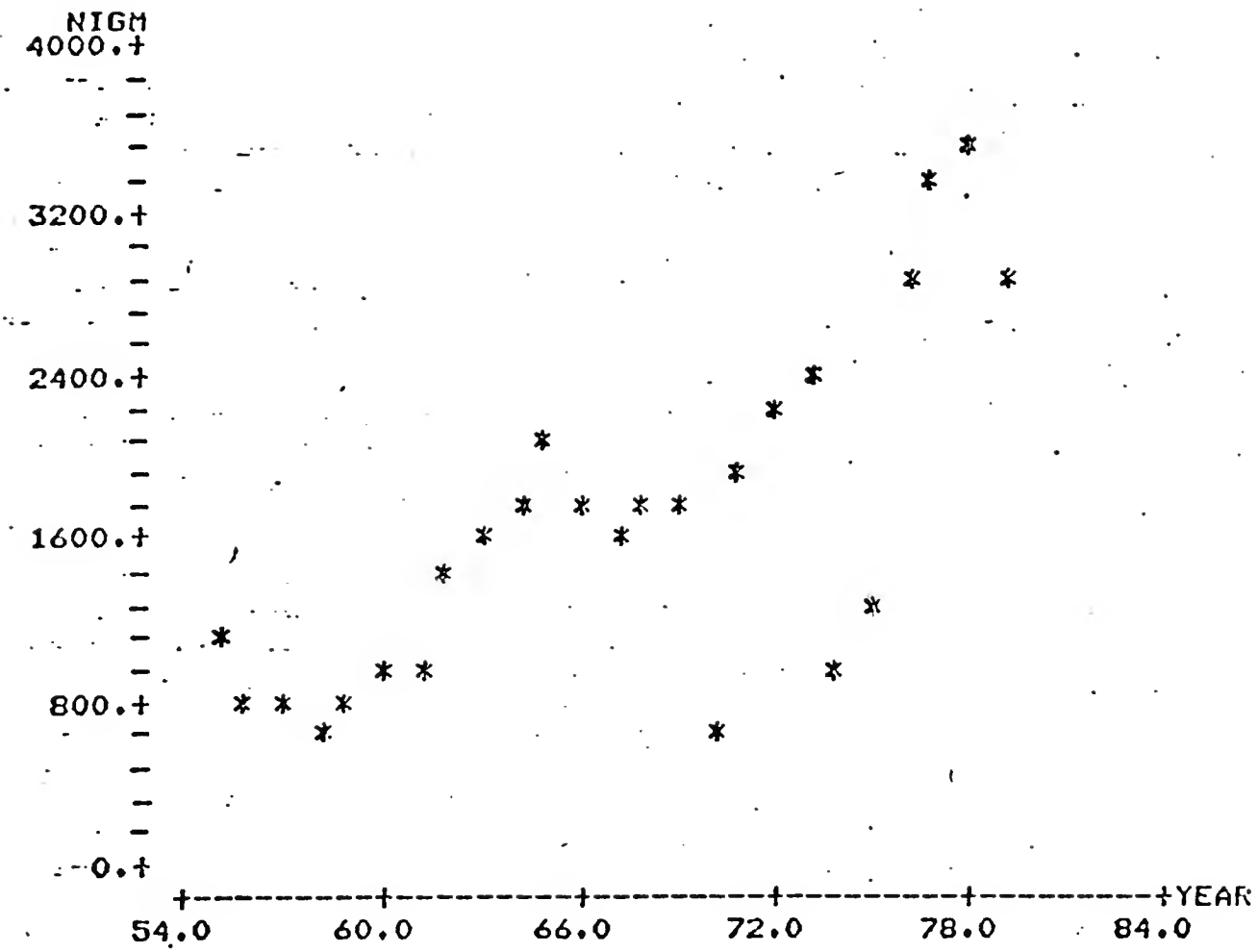
19. Chrysler and Ford reached their peak in productivity before 1963.

EXHIBIT I



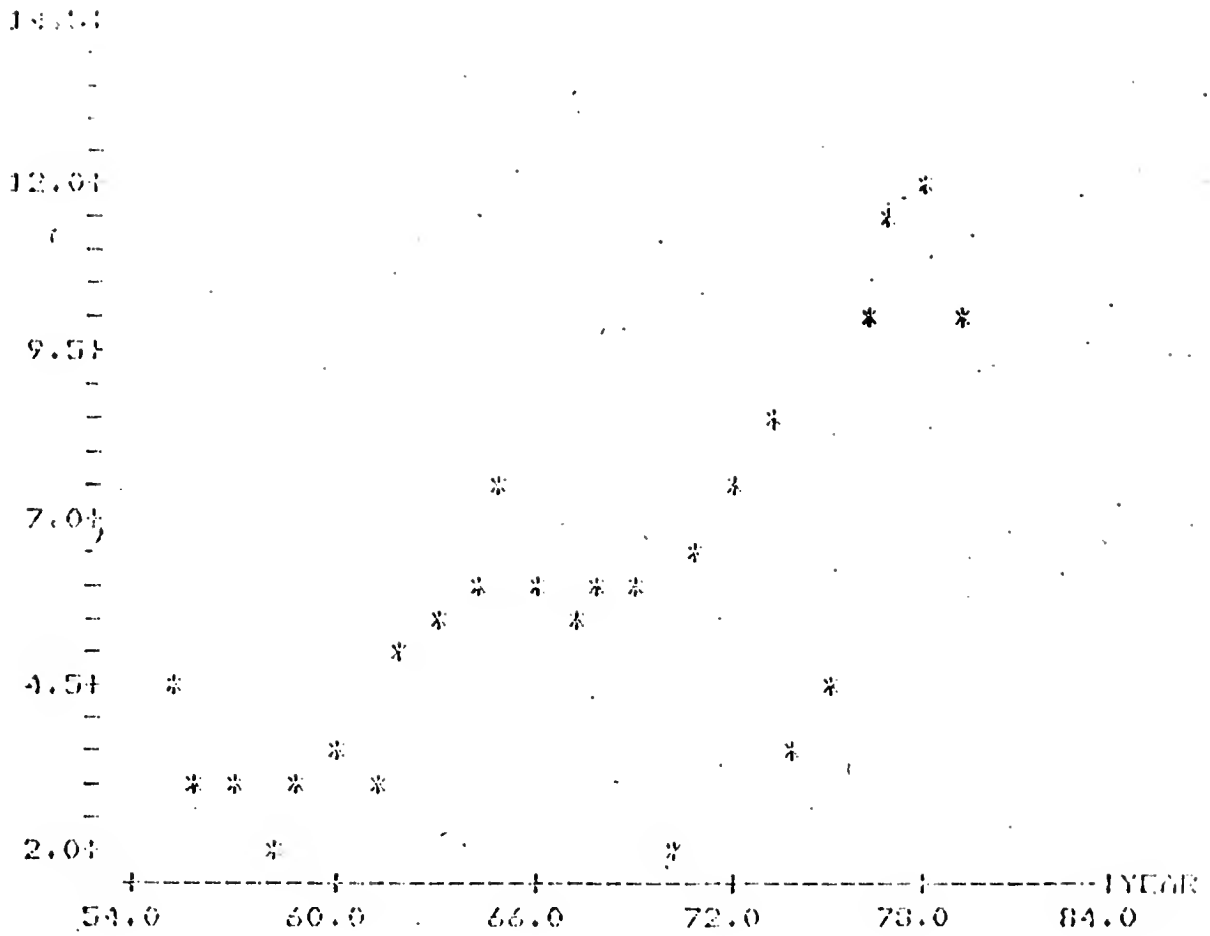
VALUE ADDED OVER PAYROLL AND BENEFITS (GM)

EXHIBIT II



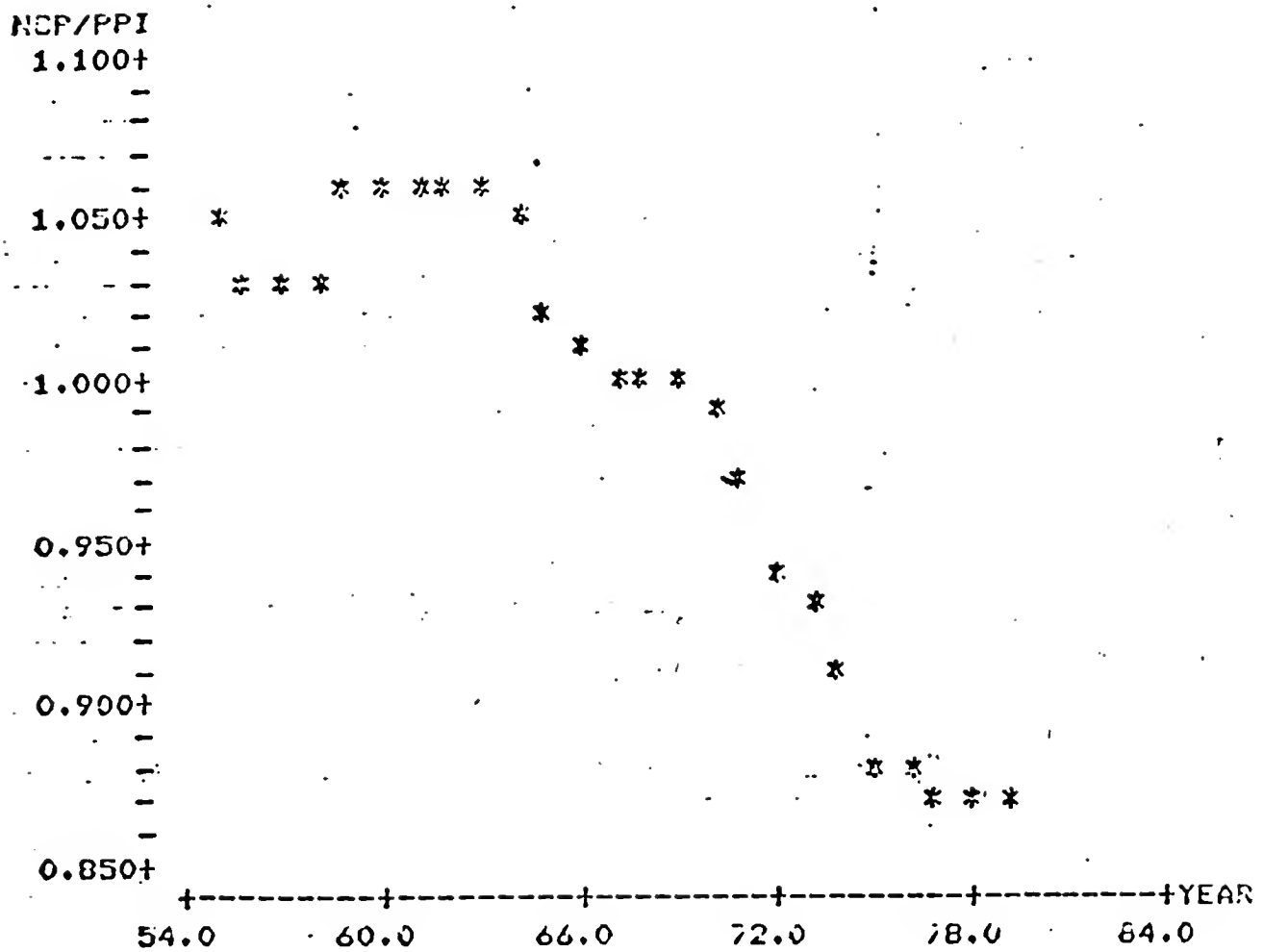
NET INCOME (GM)

EXHIBIT III



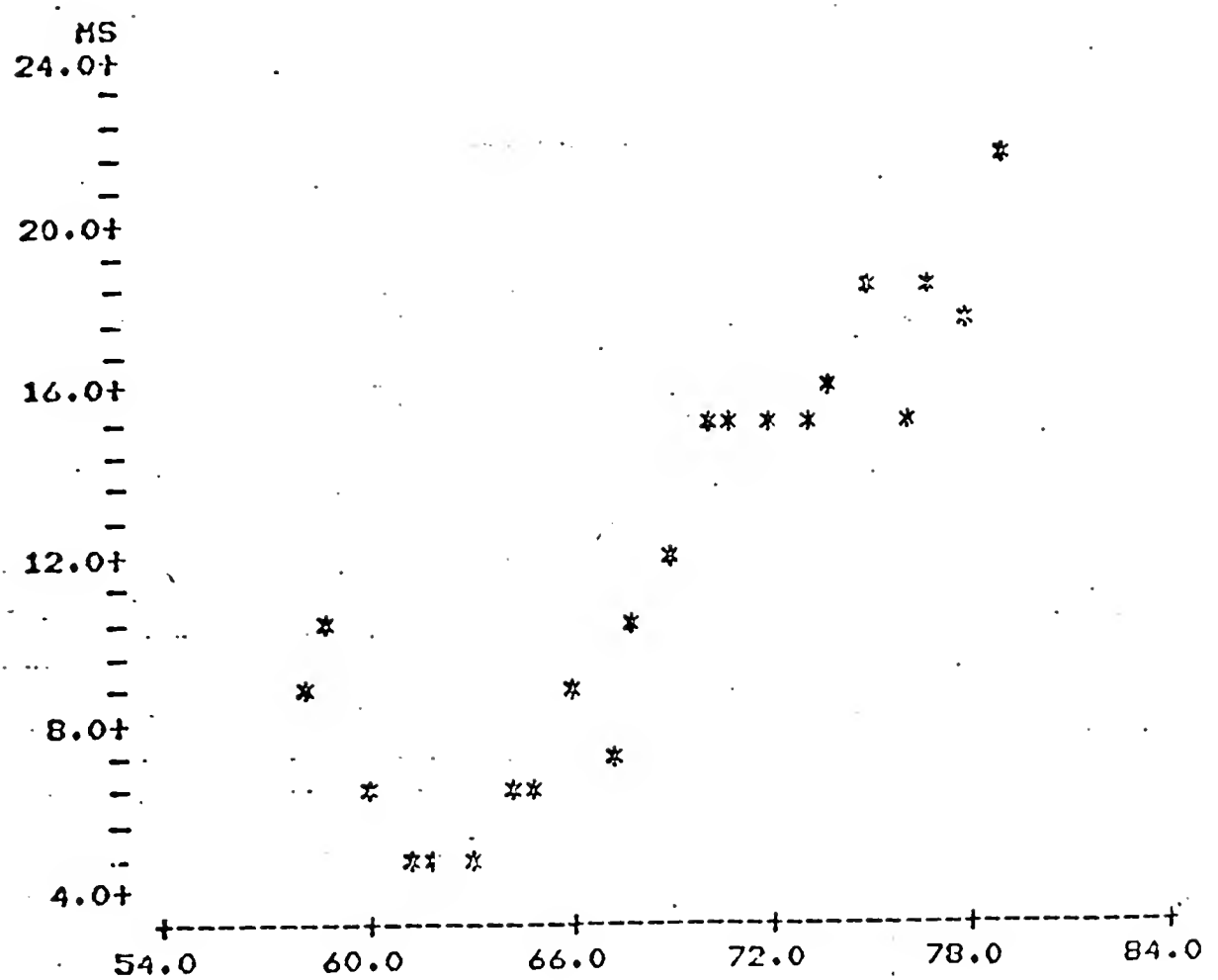
EARNINGS PER SHARE (CM)

EXHIBIT IV



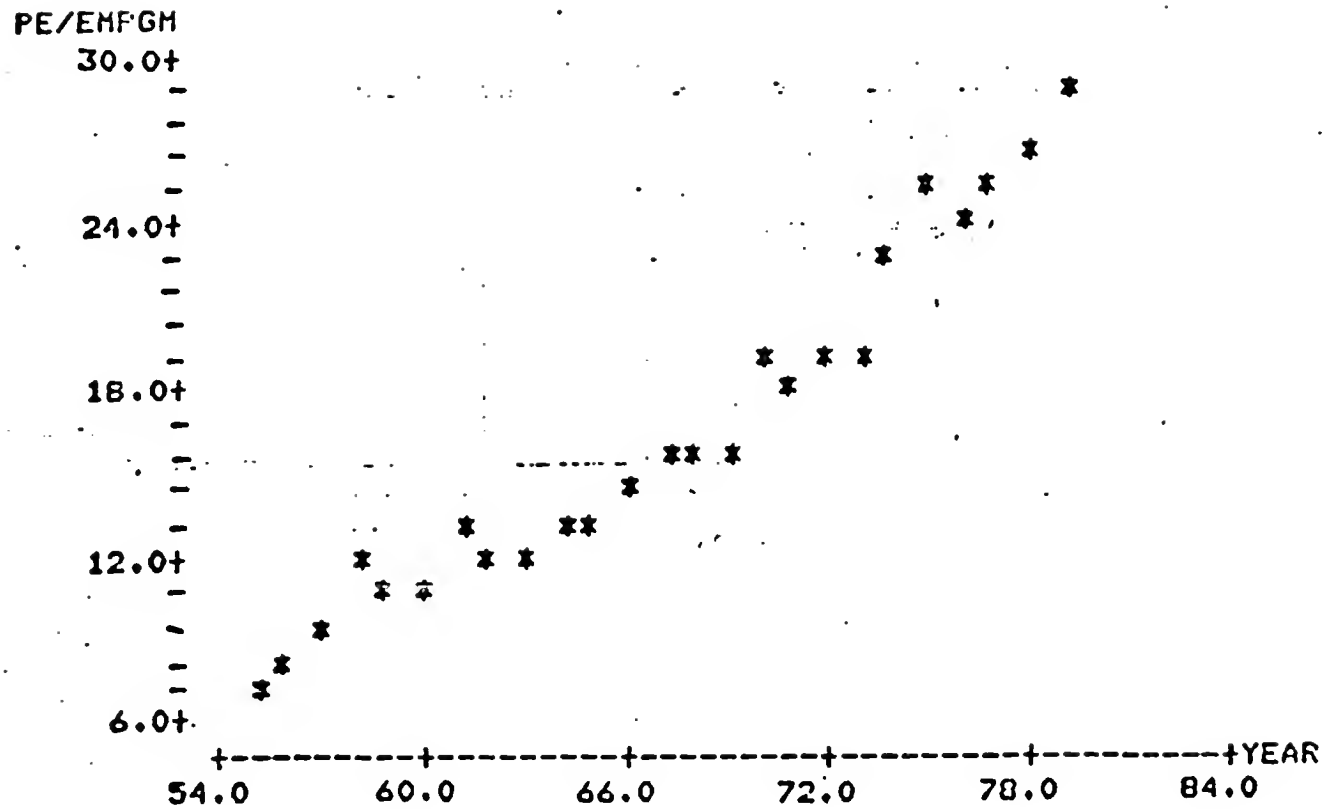
NEW CAR PRICE INDEX OVER PRODUCER PRICE INDEX (AUTOMOBILE INDUSTRY)

EXHIBIT V



IMPORTED CARS MARKET SHARE

EXHIBIT VI



PLANT AND EQUIPMENT PER EMPLOYEE (GM)

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